Physical Review D 2016 vol.94 N2

Cylindrically symmetric wormholes WhC R e: The motion of test particles

Aminova A., Brill D., Chumarov P., Shemakhin A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2016 American Physical Society.We study the radial and nonradial motion of massive test particles and photons in a three-parameter family of cylindrically symmetric wormholes WhCRe generated by the electromagnetic, dilaton, and scalar fields, with particular attention paid to the extent to which the wormhole is traversable. The wormholes are not asymptotically flat and contain a curvature singularity at one end of the wormhole. In the case of nonradial motion with conserved energy and angular momentum along a hypersurface z=const ("planar orbits") we show that, as in the Kerr and Schwarzschild geometries, we should distinguish between orbits with impact parameters greater or less than a certain critical value Dc, which corresponds to the unstable circular orbit of radius uc. For D2>Dc2 there are two kinds of orbits: orbits of the first kind arrive from infinity and turn around at the orbit's minimum radial coordinate u ("pericenter") greater than uc, whereas orbits of the second kind turn around at maximum radial coordinate u ("apocenter") less than uc and terminate at the singularity at u=-. For D=Dc orbits of the first and second kinds merge and both orbits spiral an infinite number of times toward the unstable circular orbit u=uc. For D2